

AD-A169 483

COMPONENT IMPROVEMENT PROGRAM TASK 83-01 36E133 AIR  
TURBINE STARTER(U) ALLIED BENDIX AEROSPACE UTICA NY  
FLUID POWER DIV L WILLIAMS FEB 86 8728-3173U

1/1

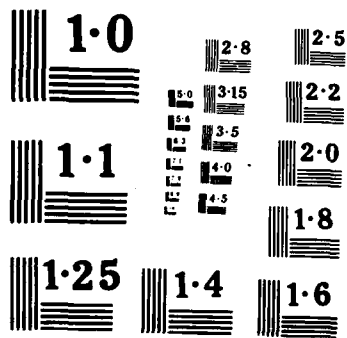
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AD-A169 483

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Bendix Fluid Power Division

Report No. 8720-3173U

Component Improvement Program  
Task 83-01  
36E133 Air Turbine Starter

February, 1986

Contract No. N00019-80-G-0607-XU04

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 **ALLIED** Bendix  
Aerospace

Report No. 8720-3173U

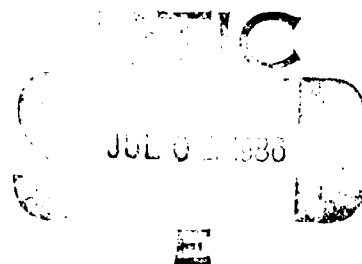
Component Improvement Program  
Task 83-01  
36E133 Air Turbine Starter

February, 1986

Contract No. N00019-80-G-0607-XU04

Prepared for:  
Department of the Navy  
Naval Air Systems Command  
Washington, DC

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## SCOPE

This report describes the analysis and results of the first half of Task 83-01, "Solid State Electronic Cutout Switch for the 36E123 (A-29) and 36E133 (A-28) Starters", conducted in accordance with NAVAIR Contract No. N00019-80-G-0607-XU04.

All analysis and initial phase testing was performed by the Engineering Department of Allied Signal Corporation, Bendix Fluid Power Division at Utica, New York.

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| A-1           |                                     |



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## 1.0 INTRODUCTION

The subject air turbine starters (ATS), Bendix Type 36E133 ATS and Type 36E123 ATS were designed to comply with MIL-S-19557, 8 and 9, respectively. The automatic cutoff control for both starters, as permitted by Paragraph 3.5.7 of the aforementioned specification, was designed to sense the speed of the starter's output drive. The existing control is a fly-weight type governor which acts to open an electrical switch at the predetermined cutout speed.

While the device has some definite advantages, field service has demonstrated that they are overridden by the following:

- ° The location of the governor (buried in the front end of the starter) makes it very difficult to service in the field.
- ° The mechanical elements are negatively influenced by the vibrational environment of the starter and engine.
- ° The electrical leads, which must be snaked through "tortuous" paths and small holes from the external connector to the switch, has caused insulation to be stripped from the leads, shorting out the switch.

In the recent past, Bendix has designed and developed an electronic solid-state "cutout switch" for turbine starters. This totally electronic device, typically monitors starter turbine speed and acts to terminate the start cycle at the turbine equivalent to the specified cutout speed.

These electronic devices are potted to isolate the components from environmental affects and the devices can be mounted externally of the starter to permit easy replacement, if necessary, or to put them in an environmentally favorable location.

Field experience has demonstrated that these electronic cutout switches are far superior to the mechanical devices.

The effort described herein was performed to adapt an existing, service proven, switch to the 36E133-4A starter, S/N 1501, supplied by the NAVY. The new starter configuration is a 36E133-6A (reference Figure 3).



## 2.0 TASK DESCRIPTION

### 2.1 Objective

Replace mechanical cutout switch with a solid-state electronic cutout switch to improve accuracy and reliability of the automatic start cycle termination in the S-3A and F-14A aircraft.

### 2.2 Work Statement

The program consisted of the following steps:

1. Evaluate feasibility of adapting a production Bendix solid state electronic switch for this application.
2. Propose design changes necessary to adopt electronic switch.
3. Prepare detail drawings of proposed switch and modified/new parts.
4. Fabricate one set of parts for test evaluation. Would include breadboard switch assembly.
5. Run development test on breadboard system.
6. Fabricate cutout switch mockup and check installation of starter on aircraft.
7. Complete design changes/detail drawings of proposed switch.

8. Fabricate final design of switch and associated hardware. (Reference Appendix 2).
9. Perform qualification test on final design. Test would include environmental tests.
10. Prepare final reports, to include ECP submittal.

### 3.0 ANALYSIS

The 36E133-4A starter (see Figure 1) is the latest Bendix configuration starter being used on the F-14A aircraft. This starter has a fly weight governor-type cutout (c/o) switch. (See Figure 2).

A more recently designed Bendix starter, currently in use on the KC-135R aircraft re-engined with the CFM56-2 engine, uses an electronic cutout switch on a highly similar turbine and gear reduction system. The high degree of similarity between this starter and the subject starters (36E123 ATS and 36E133 ATS) make the electronic device a prime candidate for adapting to subject units.

3.1 The following is a list of advantages of the electronic cutout switch over the mechanical/governor type cutout switch.

3.1.1 The electronic switch selected for the 36E133 starter is the same proven circuit presently being used on the Bendix KC-135R starter. Only a minor resistor change needed to be made.

3.1.2 The electronic cutout switch is bench set and tested easily and accurately before being installed in the starter. Conversely, the mechanical switch normally requires an adjustment involving a disassembly of the starter output spline. This is an unreliable, awkward and time consuming procedure.

- 3.1.3 The electronic device provides a positive, sharp and consistent break in the electrical circuit, while that provided by the mechanical governor is highly influenced by the varying friction of it's mechanical components.
- 3.1.4 Should the electronic switch need to be replaced, that can be done easily without removing the starter from the engine.

#### 4.0 ELECTRONIC SWITCH DESCRIPTION

The function of the cutout switch is to terminate the start cycle at a predetermined speed. An electromechanical speed sensing device is used to terminate the start cycle. The device is similar to many we have and are currently providing on other military aircraft start systems. Experience has demonstrated that the electronic devices are more reliable than the mechanical, flightweight devices.

The device consists of the following major elements:

- ° An electric relay - aircraft power is connected to the contacts only. The relay coil is powered by a small fixed stator coil generator in the starter.
- ° A single pole, magnet-fastened to the starter turbine shaft, rotated in the generator stator coil.
- ° A small electronic package - also powered by the generator, encapsulated in a potting compound and mounted in a small metal box, fastened to the starter gear housing. (See Figures 3, 4 and 5).

In operation, airframe power is applied to the starter control valve through the normally closed contacts of the relay. This arrangement permits the use of existing airframe wiring.

The small generator incorporated in the starter manifold produces an electric output in terms of power and frequency that is a direct function of turbine rotative speed and is more than ample to power the circuit and relay.

The output of the generator is directed to the electronic package through a short length of shielded cable furnished with the starter.

The output of the generator:

- ° Powers the electronic circuit in which the instantaneous turbine speed in terms of frequency is compared to a frequency equivalent to starter cutout speed.
- ° Powers the coil of the relay (normally de-energized - see Figure 6) when the electronic circuit switches it on at cutout speed.

Essentially, a part of the circuit develops a fixed pulse signal, whose frequency is equivalent to starter cutout speed relative to the starter turbine. This signal is compared to the varying frequency equivalent to the instantaneous turbine speed.

When that signal from the turbine is equal to, or less than that of the fixed pulse generator, the relay is switched on, opening the airframe circuit to the starter valve and terminating the start cycle. The relay will remain "on" with its contacts open for a short period as the starter turbine begins to coast down in speed. Latching circuits typically provided in the airframe prevent inadvertent recycling of the starter.

## 5.0 CONCLUSIONS

- 5.1 The existing electronic circuit can be used for the 36E133/123 with only a minor resistor change to accommodate the subject unit's cutout speed.
- 5.1 Breadboard testing was successfully completed and satisfactorily demonstrated feasibility. —
- 5.3 The suitability of the configuration selected was demonstrated by a successful mock-up on F-14A at Oceana Naval Air Station.
- 5.4 A failure, which occurred at about the eight hundredth cycle of a two thousand start cycle test, was not the fault of the cutout switch. The switch was found to be in excellent condition.
- 5.5 The electronic switch is available to complete the endurance evaluation program.

## 6.0 RECOMMENDATIONS

- 6.1 Accept that steps 1 through 8 of the work statement (reference para. 2.2, pg. 3) have been satisfactorily completed.
- 6.2 Complete the remaining defined test program , using the starter that will be employed in accomplishing the objectives of TASK 85-01, Bearing Improvement, as the test vehicle.



APPENDIX 1

FIGURES 1 through 6

2497432  
PART OF 248-2  
LOT PART OF 306130-9A

645011H54 12 REQ

MS20895C20-12 5 REQ

2494278 \*

MS20895C20-4 2 REQ

645094G41DY 4 REQ

2494422

2491818

645274-4 2 REQ

SOLDER WIRES PER PS32

USING ECL 9 GRADE 16

645001RR252

2494389

2487641

2 REQ

6 REQ

2 REQ

3 REQ

4 REQ

2487628

6455536

2487652

2487645

2487650

2487389

MS16395-26 3 REQ  
SEE NOTE "B"

645001RR034

2487440

645001RR032

2490518

645001RR017

2487122

6453985820

APPLY LOCTITE PR M R T  
RETAINING COMPOUND #40

645536

2487438 1 OR 2 REQ  
PER ECL C1275

645537

249437-6  
645001RR161

249666

2494397

2494397

2494397

645001RR000

2494397

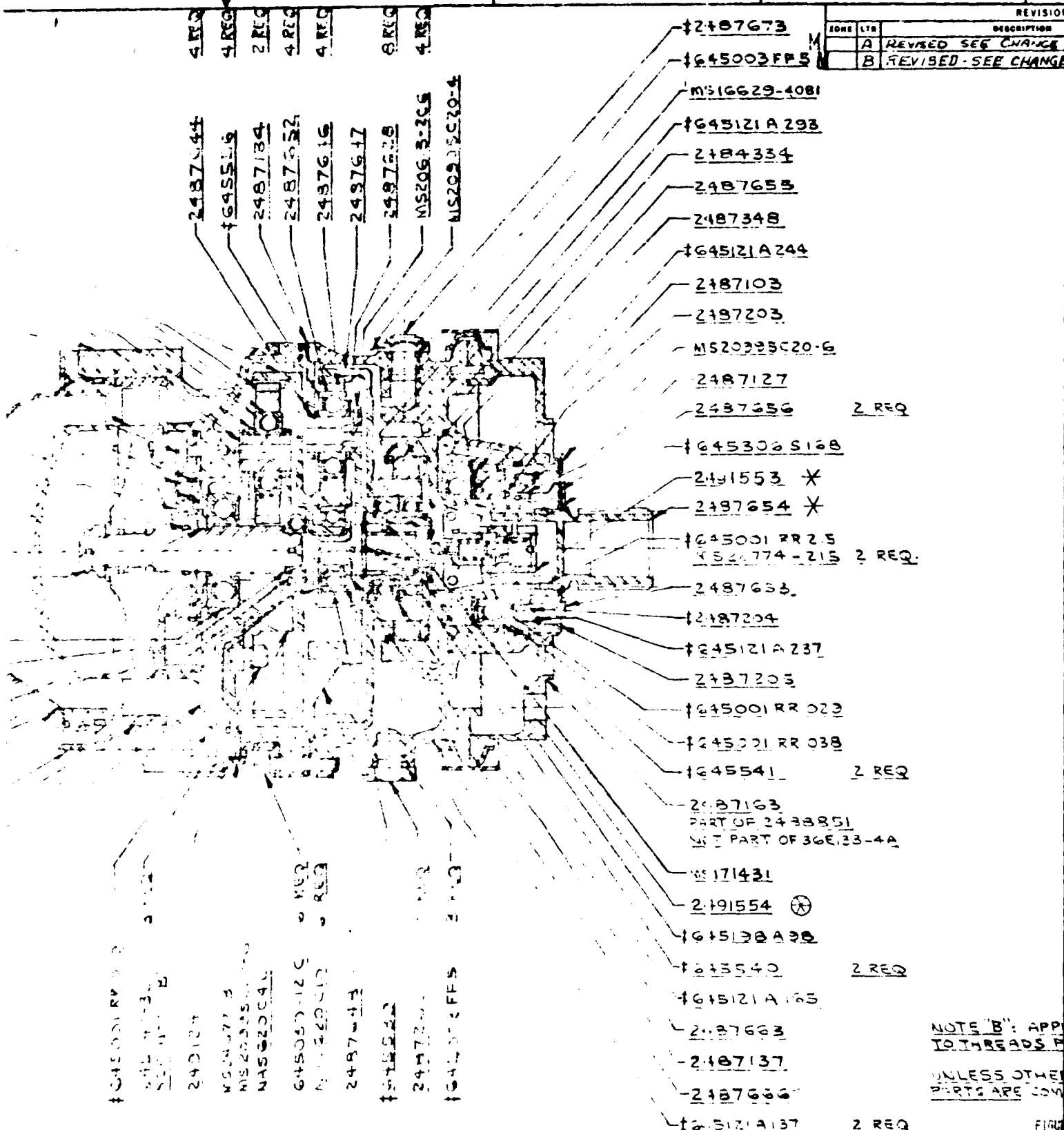
2494397

2494397

2494397

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\* INDICATES SUB-ASSEMBLY WITH  
⊗ INDICATES SUB-ASSEMBLY OF  
+ VENDOR ITEM; SEE SOURCE CONTROL ENG. FOR PRODUCTION



| REVISION |                      |
|----------|----------------------|
| EDR      | DESCRIPTION          |
| A        | REVISED SEE CHANGE   |
| B        | REVISED - SEE CHANGE |

NOTE "B": APPL  
TO THREADS F  
UNLESS OTHER  
PARTS ARE COM

SUB-ASSEMBLY WITH REPLACEABLE COMPONENTS  
SUB-ASSEMBLY OF PERMANENT CONSTRUCTION  
GIVE SEE SOURCE CONTROL OR SPECIFICATION ON  
FOR REQUIREMENT OR PART NUMBER

|  |  |                                   |  |   |  |
|--|--|-----------------------------------|--|---|--|
| UNLESS OTHERWISE SPECIFIED<br>DIMENSIONS ARE IN INCHES<br>RELATIONSHIPS MUST BE HELD AS<br>SHOWN<br>STANDARDS FOR BENDIS SPEC. 18-1000<br>AND MIL-D-1000 |  | CONTRACT NO.<br>DE J. E. 5 JAN 78 |  | The Bendix Corp.<br>Fluid Power Div.<br>Utica, New York |  |
| MATERIAL<br>SEE DETAILS  |  | FINISH<br>SEE DETAILS             |  | STARTER<br>AIR TURBINE                                  |  |
| HEAT TREAT<br>SEE DETAILS  |  | DESIGN ACTIVITY APPROVAL          |  | SIZE CODE IDENT NO.<br>D 99551                          |  |
| APPLICATION  |  | SCALE 1/1                         |  | REP. LD.  |  |

2487673

1645003FP5

MS16629-4081

1645121A293

2484334

2487655

2487348

1645121A244

2487103

2487203

MS20223C20-6

2487127

2487656 2 REQ

1645300S168

2491553 \*

2487654 \*

1645001RR25

1645001RR25 2 REQ

2487653

2487004

1645121A237

2487205

1645001RR002

1645001RR033

1645541 2 REQ

2487163

2487163

2487163

MS171431

2491554 ①

1645300A00

1645540 2 REQ

1645121A165

2487663

2487137

2487666

1645121A137 2 REQ

# REVISIONS

| ZONE | LTR | DESCRIPTION              | DATE     | APPROVAL |
|------|-----|--------------------------|----------|----------|
| A    |     | REVISED SEE CHANGE ORDER | 11/11/00 | 00086    |
| B    |     | REVISED SEE CHANGE ORDER | 08/18/00 | 20075    |

NOTE "B": APPLY ANTI SEIZE COMPOUND TO THREADS PER JAN-A-469

UNLESS OTHERWISE SPECIFIED ALL PARTS ARE COMPONENTS OF 36E133-4A

FIGURE 1

UNLESS OTHERWISE SPECIFIED  
DIMENSIONS ARE IN INCHES  
DIMENSIONS MUST BE HELD AS  
SHOWN FOR EXCEPT SPEC. TO UNLESS  
OTHERWISE SPECIFIED

SEE DETAILS

SEE DETAILS

SEE DETAILS

|              |                   |
|--------------|-------------------|
| CONTRACT NO. | DE J. E. 3 JAN 78 |
| DESIGN       | DESIGN            |
| DESIGN       | DESIGN            |
| DESIGN       | DESIGN            |
| DESIGN       | DESIGN            |
| DESIGN       | DESIGN            |
| DESIGN       | DESIGN            |
| DESIGN       | DESIGN            |
| DESIGN       | DESIGN            |
| DESIGN       | DESIGN            |

The Bendix Corporation  
Fluid Power Division  
Udon, New York

STARTER ASSEMBLY,  
AIR TURBINE

36E133-4QA

SCALE 1/1 REF ID: A927 SHEET 1 OF 1

36E133-4QA

|                |                |                              |
|----------------|----------------|------------------------------|
| <u>2487107</u> | <u>16 REQ.</u> | FLYWEIGHT, GOVERNOR          |
| <u>2491536</u> |                | INSULATOR & PLUNGER COMPLETE |
| <u>2489620</u> |                | SPRING, GOVERNOR             |
| <u>2487699</u> |                | NUT, ADJUSTING - GOVERNOR    |
| <u>2487701</u> |                | HOUSING, GOVERNOR            |

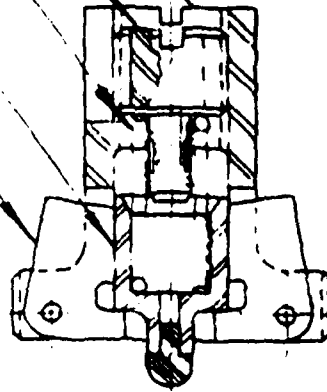
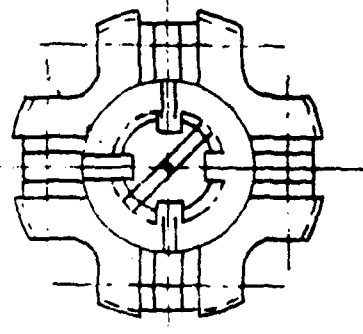
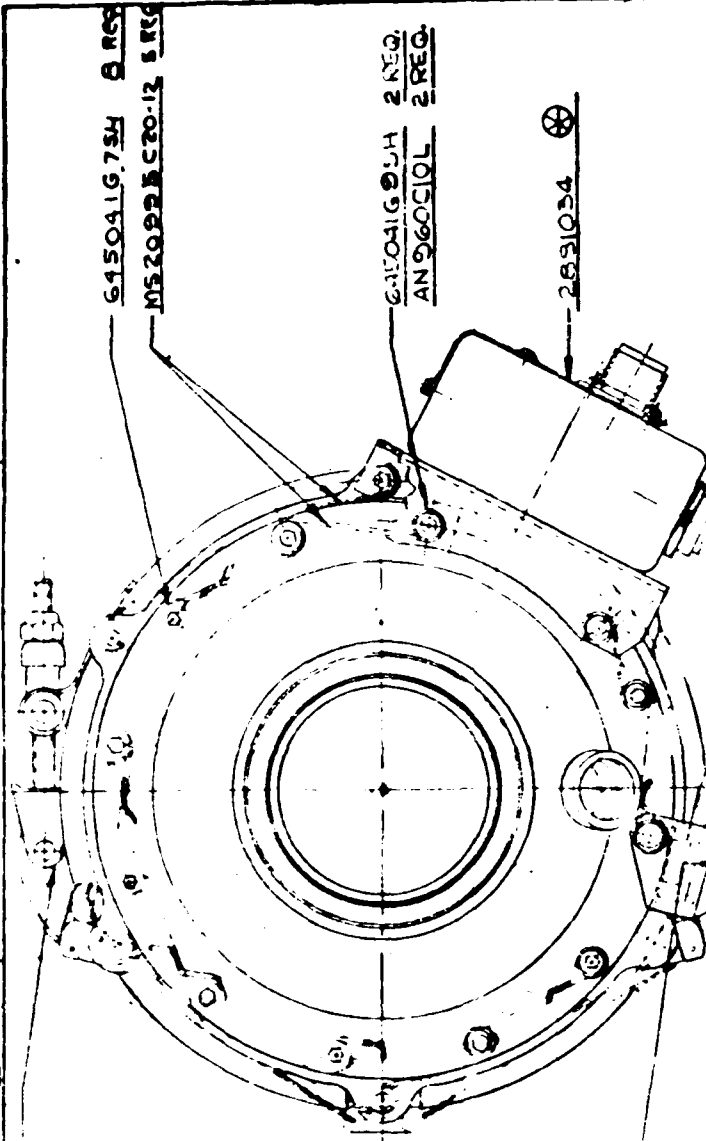


Figure 2 - 36E133-4A Governor  
Type.Cutout Switch  
P/N 2491553 Assembly



645041G.754 2 REQ  
MS20925C20-12 5 REQ

645041G.954 2 REQ  
AN960C10L 2 REQ

2631034

- 2881075
- MS 2035-26 3 REQ
- 645001RR034
- 2487440
- 645001RR030
- 2490518
- 645001RR011
- 2497122
- 248034 (SEE NOTE C)
- 248034 (SEE NOTE C)
- 2831079 (SEE NOTE C)
- 248034 (STAKE INTO FL. IT)
- 645536
- 2487439 1 OF 2 PER 2
- PER 25101275
- 645537

- 1645001RR252
- 2494289
- 2487641
- 2487628
- 1645556
- 2487652
- 2487645
- 2487650

- 4 REQ
- 4 REQ
- 2487644
- 1645556

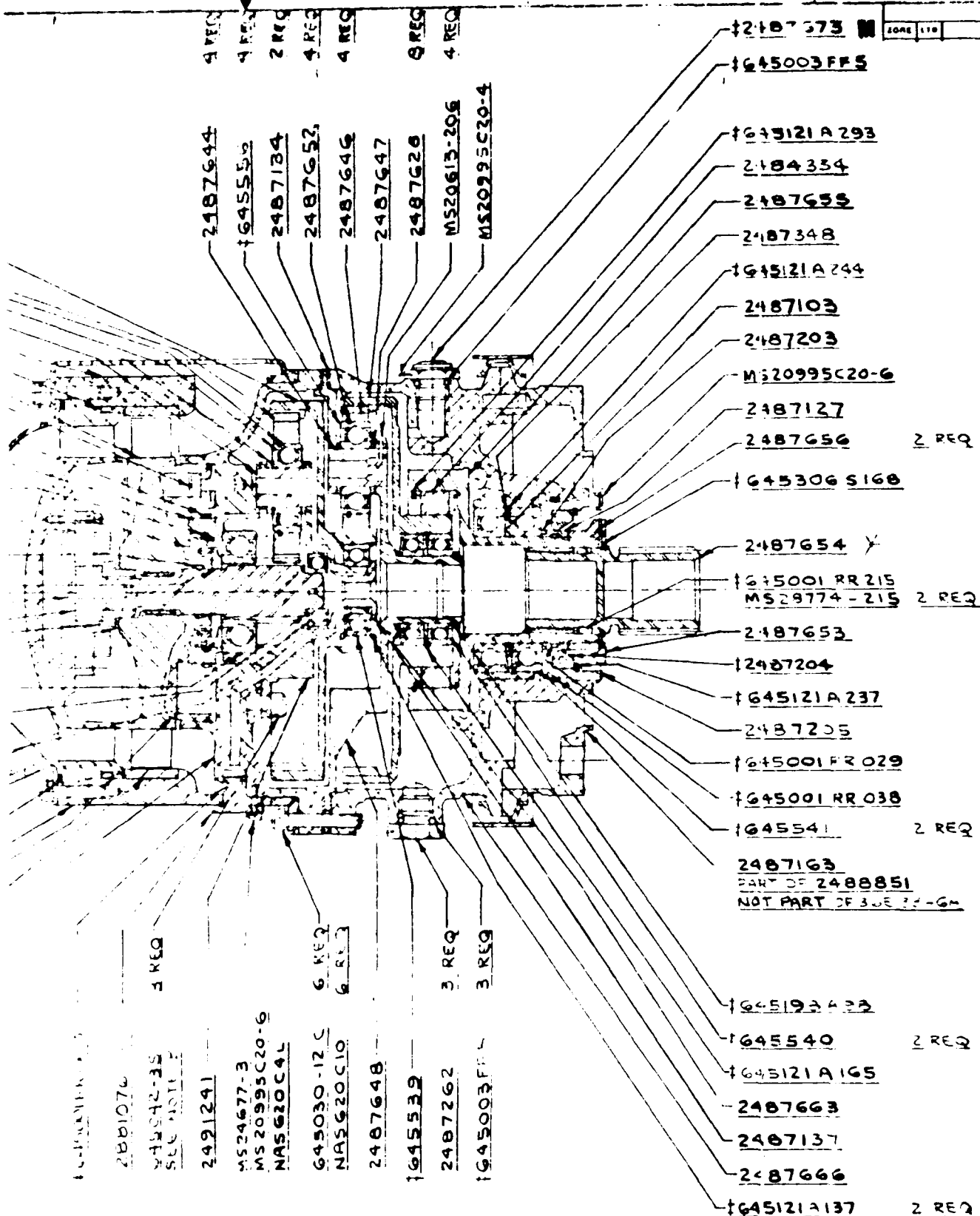
249432  
PART OF 249432  
NOT PART OF 249432

TORQUE TO 40-45 LB-FT  
ABOVE RUNNING TORQUE

- 2494387
- 2494386
- 2494388
- 645001RR002
- 2881076
- 645042-35 3 REQ
- SEE NOTE 2
- 2491241
- MS24677-3

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X INDICATES SUB-ASSEMBLY WITH PER  
X INDICATES SUB-ASSEMBLY OF PER  
+ VENDOR ITEM; SEE SOURCE CONTROL  
CONTROL DWG. FOR PROCUREMENT



NOTE 'C':  
CLEAN PARTS THO  
PRIMER T. TO M  
TO DRY 3 TO 5 M  
TO DRY 242 TO  
ACREVELE NIME  
ACQUIRED. CLEA  
FROM PARTS A  
AMBIENT TEMPE  
HOURS MIN. BE

NOTE 'B': APPL  
TO THREADS P

SUB-ASSEMBLY WITH REPLACABLE COMPONENTS  
SUB-ASSEMBLY OF PERMANENT CONSTRUCTION  
IM. SEE SOURCE CONTROL OR SPECIFICATION  
G. FOR PROCUREMENT OF PART NUMBER

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|--|--|--------------------------|--|---|--|
| UNLESS OTHERWISE SPECIFIED<br>DIMENSIONS ARE IN INCHES<br>RELATIONSHIPS MUST BE HELD AS<br>SHOWN<br>TOLERANCES PER BENDIS SPEC IN UNOS<br>AND MIL D 100B |  | CONTRACT NO.             |  | The Bendis Corp.<br>Plant - New York<br>Office - New York |  |
| MATERIAL<br>SEE DETAILS  |  | DR. C.W. 10 JAN 55       |  | STARTER<br>AIR TURB                                       |  |
| FINISH<br>SEE DETAILS  |  | CR 2.5m 8.5L15           |  |   |  |
| HEAT TREAT<br>SEE DETAILS  |  | NET. SEC. 1.245.15       |  | SIZE CODE BODY 08   |  |
| OTHER ACTIVITY APPROVAL  |  | DESIGN ACTIVITY APPROVAL |  | D. 99551  |  |
| APPLICATION  |  | SCALE 1/1                |  | REVISION  |  |

REVISIONS

2487673

645003FF5

645121A293

2484334

2487655

2487348

645121A244

2487103

2487203

MS20995C20-6

2487127

2487656 2 REQ

645306 S168

2487654 X

645001 RR215  
MS29774-215 2 REQ

2487653

2487204

645121A237

2487205

645001 RR029

645001 RR038

645541 2 REQ

2487163

PART OF 2488851  
NOT PART OF 30E 17-6H

645192A22

645540 2 REQ

645121A165

2487663

2487137

2487666

645121A137 2 REQ

NOTE C:  
CLEAN PARTS THOROUGHLY. APPLY LOCTITE  
PRIMER TO MATING SURFACES ALLOW  
TO DRY 3 TO 5 MINUTES. APPLY LOCTITE  
TO MATING SURFACES. Wipe off  
EXCESS IMMEDIATELY. Wipe off  
EXCESS. CLEAN EXCESS LOCTITE  
FROM PARTS ALLOW TO DRY FROM  
AMBIENT TEMPERATURE FOR FOUR (4)  
HOURS MIN. BEFORE USE.

NOTE B: APPLY ANTI SEIZE COMPOUND  
TO THREADS PER JAN-A-663

UNLESS OTHERWISE SPECIFIED  
DIMENSIONS ARE IN INCHES  
TOLERANCES MUST BE HELD AS  
SHOWN  
ANALYZED PER BENDIS SPEC. ON JUNE  
13, 1968

SEE DETAILS

SEE DETAILS

SEE DETAILS

CONTRACT NO.  
BY CW. 10 JAN 68  
TE  
CA 2 04m 02.15  
DET 300 10.5 h  
FANC 20 5 20.15  
ENG 20 22.00 15

DESIGN ACTIVITY APPROVAL

OTHER ACTIVITY APPROVAL

The Bendix Corporation  
Fluid Power Division  
Utica, New York

STARTER ASSEMBLY,  
AIR TURBINE  
FIGURE 3

SIZE 1/1

D 99551

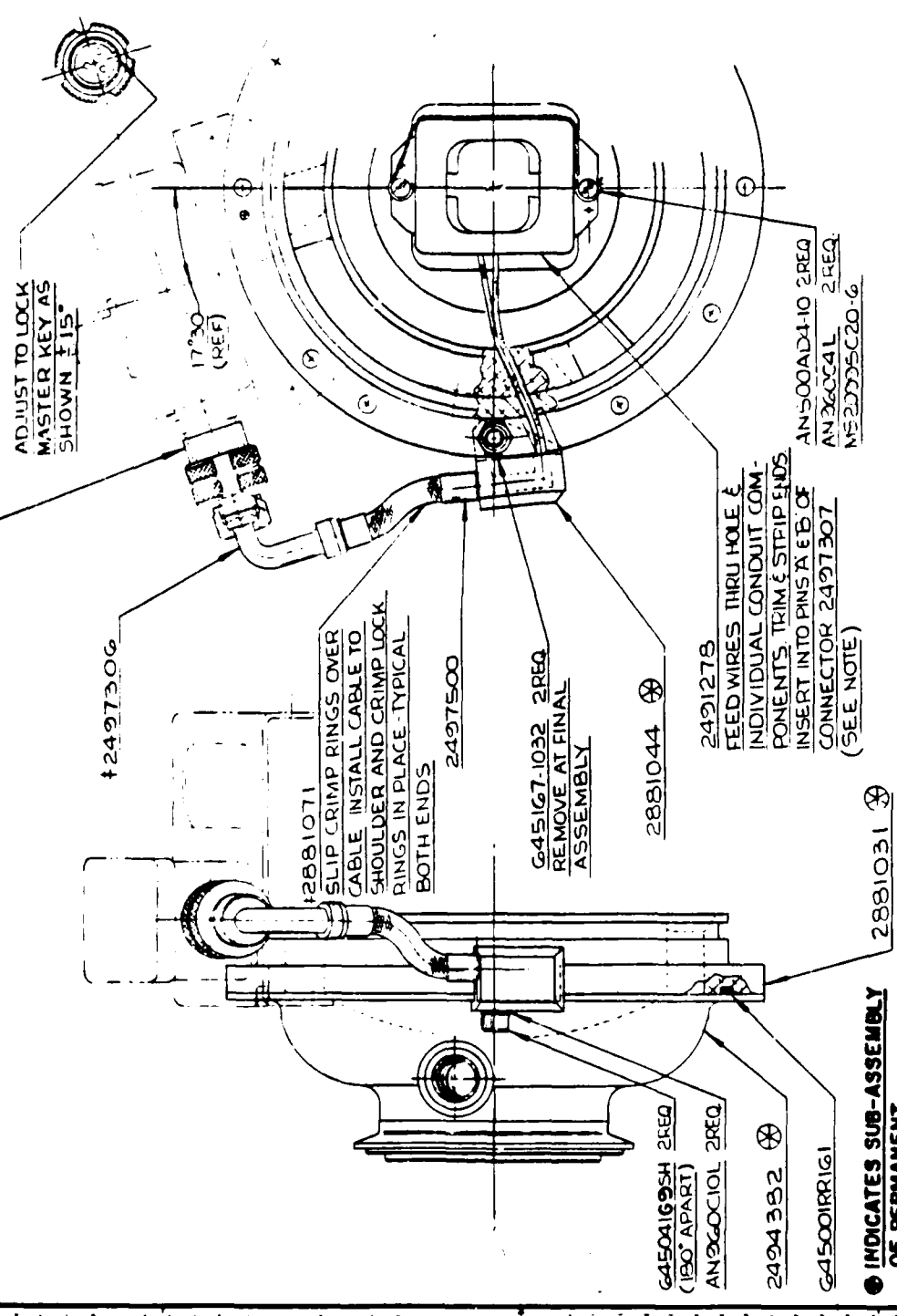
36E133-6QA

SCALE 1/1

SHEET



|                   |             |           |           |
|-------------------|-------------|-----------|-----------|
| # 297307          | IONB        | DATE      | APPROVAL  |
| INSTALL AS SHOWN  | DESCRIPTION |           |           |
| CONTRACTOR/CLIENT | JOSE LTY    | 1 MAY 66  | 107506    |
|                   | A           | 6450419SH | 6450419SH |



NOTE. PERFORM CONTINUITY CHECK  
ACROSS PINS 'A' & 'B' AND EACH  
PIN TO GROUND TO INSURE  
AGAINST FRAY WIRES OR INCORRECT  
WIRING.

GENERATOR WIRES TO BE TWISTED  
APPROX. 190° PER INCH INSTALLED

|   |  |  |  |
|---|--|--|--|
| * <u>INDICATES SUB-ASSEMBLY WITH REPLACEABLE COMPONENTS</u> |  | * <u>VENDOR ITEM - SEE SOURCE CONTROL OR SPECIFICATION CONTROL DRAWING FOR PROCUREMENT OR PART NO.</u> |  |
|---|--|--|--|

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| STANDARD FOR DIMENSIONS OF 1/16" AND 1/32" - 1993                                       |  | DATE                    |  |   |  |
| MATERIAL  |  | BY                      |  |   |  |
| SEE DETAILS   |  | DATE                    |  |   |  |
| FINISH  |  | DATE                    |  |   |  |
| SC E 133 - CA   |  | USED ON                 |  |   |  |
| NEXT ASBY   |  | USED ON                 |  |   |  |
| APPLICATION   |  | OTHER ACTIVITY APPROVAL |  |   |  |
| SCALE   |  | SIZE (PICK ONE)         |  | 2881046   |  |
| C   |  | 99551                   |  |   |  |
| SCALE   |  | INCHES                  |  |   |  |

| FORM | DATE | DESCRIPTION                      |
|------|------|----------------------------------|
| 110  | 1954 | REDESIGNED & REVISED WAS 5-12-54 |
| A    |      |                                  |

MS35275-215 4 REQ.  
MS21042-04 4 REQ.

MS3102R10SL4P  
D38999/24FA9-5PN

MS20995C20-2

MS35275-212 4 REQ

MS20995C20-5

FILL BOX WITH EMERSON  
AND CLIMMINGS STYCAST  
# 2651 RESIN & CATALYST II  
PER ES1-UI382 - FILL TO TOP  
OF STIFFENER

2881065-1  
BOND IN PLACE  
(SEE NOTE)

2881042

2881068

2881045  
POSITION BOARD  
ASSY WITH RELAY  
IN POSITION SHOWN

CONNECT PIN 2 A2 SHOWN AND TEST  
PER TS-UI842 BEFORE FILLING  
WITH STYCAST.  
BOND AS FOLLOWS:  
APPLY THIN COAT OF 3M TYPE EC1357  
TO BONDING SURFACES OF BOTH  
PARTS - PRESS FIRMLY TOGETHER

D38999/24FA9-4PN  
RECEPTICLE

INSTALL PIN ONLY  
- WIRE CONNECTION  
NOT USED

FROM  
2881045

MS3102R10SL4P

A GREEN  
B BROWN

|   |  |                          |  |  |  |
|---|--|--------------------------|--|--|--|
| UNLESS OTHERWISE SPECIFIED<br>DIMENSIONS ARE IN INCHES<br>RELATIONSHIPS MUST BE HELD AS<br>SHOWN<br>TOLERANCES PER ASME Y14.5M-1983<br>AND Y14.5-1983 |  | CONTRACT NO.             |  | Allied Corporation<br>Bendix Fluid Power Division<br>Utica, New York |  |
| SEE DETAILS   |  | DR. C.W. 3 MAY 85        |  | FIGURE 5   |  |
| MATERIAL  |  | CER. 8000 12 MAY 85      |  | BOX ASSEMBLY,<br>SPEED CONTROL                                       |  |
| FINISH  |  | REF. 500 14 MAY 85       |  | SHEET 1/1  |  |
| THERM   |  | PROC. 100 21 MAY 85      |  | C 99531  |  |
| HEAT TREAT  |  | DESIGN ACTIVITY APPROVAL |  | 2881034  |  |
| NEXT APPY   |  | OTHER ACTIVITY APPROVAL  |  | SCALE 1/1  |  |
| APPLICATION   |  |                          |  | SHEET  |  |

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SYSTEMS WITHOUT PERMISSION IN WRITING FROM BENDIX FLUID POWER DIVISION



APPENDIX 2

PARTS LISTS

Reworked Parts for 36E133-6A ATS

| <u>Qty.</u> | <u>P/N</u> | <u>Description</u>  |
|-------------|------------|---|
| 1           | 2881074    | Shaft, Rotor (reworked from 2487094)                                  |
| 1           | 2881073    | Rotor, Turbine (reworked from 2487588)                                |
| 1           | 2881045    | Board Ass'y., Cutoff Switch (reworked from 36E153, P/N 2497332 Board) |
| 1           | 2496167    | Flange, Stator (changed for -6A)                                      |

New Parts for 36E133-6A ATS

|   |               |   |
|---|---------------|---|
| 1 | 2881079       | Nut, Rotor                                    |
| 1 | 648894        | Rotor, Generator (used on 36E153 ATS)         |
| 1 | 645199-4      | Screw, Button HD (used on 36E153 ATS)         |
| 1 | 2881030       | Stator, Air Turbine                           |
| 1 | 2491278       | Generator, Cutoff Switch (used on 36E153 ATS) |
| 2 | AN500 AD4-10  | Screw, Fill HD                                |
| 2 | AN960C4L      | Washer, Flat                                  |
| 1 | MS20995C20-6  | Wire, Tie                                     |
| 1 | 2881044       | Adapter, Conduit                              |
| 1 | 2881071       | Shield, Braided Wire                          |
| 1 | 2497500       | Ring, Crimp                                   |
| 1 | 2497306       | Elbow, Connector                              |
| 1 | 2497307       | Plug, Electrical Connector                    |
| 2 | 645041H9SH    | Screw, Soc. HD. CAP                           |
| 2 | AN960C10L     | Washer, Flat                                  |
| 2 | 645167-1032   | Nut, Hex                                      |
| 1 | 2881076       | Plug, Housing                                 |
| 8 | 645041H7SH    | Screw   |
| 2 | 645041H9SH    | Screw, Soc. HD. CAP                           |
| 2 | MS20995C20-12 | Wire, Tie                                     |
| 1 | 2881034       | Box Ass'y. Speed Control                      |
| 1 | 2881084       | Data, Ident.                                  |

36E133-4A ATS Parts Replaced by New 36E133-6A

ATS Parts

| <u>Qty.</u> | <u>P/N</u>   | <u>Description</u>                   |
|-------------|--------------|--------------------------------------|
| 1           | 2487123      | Bushing, Pilot                       |
| 1           | 645398S820   | Nut, Lock, Thin                      |
| 1           | 2491554      | Contact Ass'y. Governor Type         |
| 1           | 2491553      | Housing, Assembly, Governor          |
| 1           | 2496169      | Stator, Air Turbine                  |
| 1           | MS16555-627  | Pin, Dowel                           |
| 1           | 645001RR252  | Gasket, "O" Ring                     |
| 1           | 2494378      | Conduit Ass'y., Electrical Connector |
| 1           | 2491818      | Gasket, Electrical Connector         |
| 2           | 645274-4     | Tubing, Shrinkable                   |
| 1           | 2494422      | Connector, Electrical                |
| 4           | 645094G41DY  | Screw, Socket, HD. CAP               |
| 2           | MS20995C20-4 | Wire, Tie                            |
| 1           | NAS620C4L    | Washer, Flat                         |
| 1           | MS24677-3    | Screw, Socket HD. CAP                |
| 1           | MS20995C20-6 | Wire, Tie                            |
| 1           | 2494477      | Data, Ident. Plate (MIL Type)        |

END

DT/C

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